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**Workers' Effort:
A Comparison Between Capitalist
and Cooperative Firms**

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WORKERS' EFFORT: A COMPARISON BETWEEN CAPITALIST AND COOPERATIVE FIRMS

ABSTRACT

The purpose of this paper is to establish a comparison between capitalistic and cooperative firms by focusing on workers' effort during productive activity in a model in which owners and/or managers suffer from information asymmetries. In our model agency relations do not mainly concern the design of incentive mechanisms but the setting of an optimal form of monitoring, centered on management control (albeit incomplete) on workers' effort during production.

By using a principal-agent framework, we show that in the presence of information asymmetries on the actual effort offered by each worker, the cooperative firm requires less monitoring to achieve an optimal level of worker effort. Being also owners of the firm and choosing the person responsible for management functions inside their circle, cooperative workers develop relations based on solidarity and forms of 'peer monitoring' which reduce monitoring costs. Consequently, the manager of the cooperative firm can devote more of his/her effort to organizational activity which increases the efficiency of the production process. Hence, in terms of working effort, governance in the cooperative firm is more efficient than in the capitalist firm.

However, the opposite result is achieved when the purchasing cost of capital in the two kinds of firm is taken into consideration. Therefore, the financial constraints to the purchase of capital reduce the production efficiency of the cooperative relatively to the capitalistic firm. In addition, such constraints represent an obstacle to achieving an optimal rate of long-term growth for the cooperative firm and benefiting from the related virtuous circle between increases in the level of employment and growth rate.

JEL Classification:

L23 (Organization of production, L2= Firm Objectives, Organization, and Behavior)

P13 (Cooperative enterprises)

D21 (Firm behavior: theory)

D82 (Asymmetric and private information – mechanism design)

1. Introduction

Cooperative firms have played and continue to play a major role in the world economy. Suffice it to consider that the full set of their members – both workers and consumers - amounts to more than one billion people.¹ Furthermore, the importance of this sector has been proved by the choice of the United Nations to designate 2012 as the year of cooperatives. It thus comes as no surprise that, in the last thirty years, the economic literature has dedicated increasing attention to cooperative firms. However, and this *is* quite surprising, the theoretical and empirical analyses of this important component of the world economy have been progressively confined to significant but very specific areas such as the issue of worker productivity and that of constraints to access to financial capital (see for instance: Pencavel et al. 2006, Rey and Tirole 2007, Ellerman 2007, Fakhfakh et al. 2009, Pérotin 2010). As a result, the cooperative sector, although it has been studied by many great economists in the past (see Walras 1865, Mill 1871, Marshall 1890), has almost disappeared from current micro and macroeconomics textbooks (Kalmi 2007).

One of the most detrimental effects of this approach has been the disappearance in recent economic theory of a stream of analysis which emerged in the late 1950s (Ward 1958) and developed during the 1970s and 1980s: the comparison between cooperative and capitalist firms in terms of organization and their respective degree of efficiency.² Although the comparison in question achieved no general, definitive conclusions, by the end of the 1980s economic analysis had focused only on the capitalist model. As a consequence, all the progress accomplished by microeconomic theory around those years (see Akerlof 1970, Spence 1974, Mirrlees 1975, Rothschild and Stiglitz 1976) and the related criticism leveled at the neo-Walrasian program were applied more to the capitalist firm than to the cooperative. In this respect, it is quite instructive to refer to the literature on agency costs and market failure based on imperfect or asymmetric information (Jensen and Meckling 1976, Holmstrom 1979, Myers and Majluf 1984, Grossman and Hart 1986, Hart 1988). Some have sought to use these strands of the literature to re-propose a comparison between capitalist and cooperative firms in terms of efficiency.³ Despite that, the very focus of the different models on agency costs and imperfect or asymmetric information has continued to be confined to the capitalist firm.

This result represents a missed opportunity. Attention to agency costs and market failure put the focus back on Coase's framework (1937) and gave a solid analytical basis to Williamson's neo-institutionalist approach (1973, 1979, 1985). The consequent definition of the firm as a complex organization

¹ According to the *Report* issued by the International Co-operative Alliance 'Global 300', in 2008 the 300 largest cooperatives in the world produced a value added equal to 1,600 billion dollars, which is the equivalent of the yearly GDP of the ninth largest economic system on the international market.

² See for example: Vanek 1970 and 1977, Bonin 1981, Ireland and Law 1981, Bradley and Gelb 1983, Bonin 1984, Miyazaki 1984, Ben-Ner 1988, Hansmann 1987 and 1988. For an extended in-depth review, see: Bonin et al. 1993.

³ See for instance: Hansmann (1990 and 1996), Dow (1993), Mikami (2002); see also: Albanese (2001). In this respect, the most important contribution is, however, offered by Hart and Moore (1996 and 1998).

characterized by the internalization of a set of contractual nexus and their subordination to hierarchical relations (principle of authority), made the concepts of property rights and governance crucial. This offered a stronger theoretical justification to the coexistence of different kinds of firms in the market. Brief reference to those analytical steps that connect agency models to property rights and firms' governance will be useful to clarify the point.

The presence of "incomplete contracts" and the designation of the firm as a "collection of physical activities" which represent the main ingredients of the Hart-Moore (1988 and 1990) models, imply that the problem of attributing the residual rights of control is unsolved. Allocation of these rights in the form of property rights, which legitimate their holders to decide about the utilization of non-human activities in all situations not regulated *ex ante* by contracts and to get the residual income, is efficient if it rewards the type of agents that carry out the "indispensable" function in the firm.⁴ However, according to Hansmann's analysis (1996) the attribution of property rights to "indispensable agents" minimizes agency costs only if those agents have the highest negotiation costs on the market. That said, property rights introduce into the firm a non-contractual principle which requires regulation as regards management of the residual rights of control. Leastways in the definition of Rajan and Zingales (1998 and 2001; see also: Zingales 1998 and 2000), a firm's governance is precisely that complex system of (self)regulation that places constraints upon owners' decisions and especially upon their *ex post* appropriation of the residual income.⁵ Furthermore, with respect to Hart and Moore (1990), Rajan and Zingales attach more importance to the neo-institutionalist concept of "specific investment". Thus the firm becomes a combination of activities and specialized agents, and appropriation of the residual income appertains to those agents who actually made the most specific and hence riskiest investments.

In this context, governance can be defined as that system of rules and constraints which shapes a firm's activities that are not guaranteed by external rules and by contracts (which are incomplete). Such rules and constraints refer to decisions and *ex ante* negotiations as well as to monitoring and *ex post* distribution of net income (cf. Zingales 1998). Hence agency relationships and governance offer powerful analytical tools to revisit, on a more modern theoretical basis, the comparison between cooperative and capitalist firms in terms of their respective degree of efficiency.

⁴ Hart and Moore (1990, p. 1133) define as "indispensable" for a given activity the agent whose absence would render the contribution of this same activity irrelevant to the "marginal product of the investment" for the whole set of agents entering the contract.

⁵ In the literature we now have a large number of definitions of corporate governance. In descriptive terms, however, we can state that governance regulates a subset of relations between different groups of agents who hold specific interests in a given firm or company (stakeholders, obviously besides shareholders). Referring to fields usually regulated neither by primary norms nor by contractual agreements, governance is a form of (self)regulation which assesses the temporary power equilibria between these different interest groups. Thus the fields in which governance can apply vary from the relations between shareholders and management to the working of boards of directors and of firms' control bodies, from self-regulation codes towards sellers and consumers to aspects concerning workers' protection and involvement.

The purpose of this paper is to establish a comparison between these two kinds of firms by focusing on workers' effort during productive activity in a model in which owners and/or managers suffer from information asymmetries. In the part dedicated to the cooperative firm (here limited to a cooperative of "production and work"; cf. *infra*), this comparison is interlaced with the assessment of costs and opportunities connected with participation of workers in a firm's capital. In our model agency relations do not mainly concern the design of incentive mechanisms but the setting of an optimal form of monitoring, centered on management control (albeit incomplete) on workers' effort during production. What emerges, furthermore, is that acquisitions of ownership shares by each worker in the cooperative firm can increase the financing costs of productive capital. We conclude that, compared with the capitalist firm, the cooperative firm has efficiency advantages in terms of monitoring worker activity but shows inefficiencies in capital acquisition.

To prove this conclusion, we first examine the objective functions of the two different firms (that is, capitalist and cooperative) and specify the main assumptions characterizing the model (Section 2). It then becomes possible to specify the problem of optimization in the capitalist firm, with respect to the amount of managerial monitoring of worker activity as well as the employment level (Section 3), and the analogous problem of optimization in the cooperative firm with respect to the amount of managerial monitoring and the share of firm's profits to be allocated to reserves (Section 4). The equilibrium conditions, which depend on the solution of these two problems of constrained maximization, provide a new approach to comparing the efficiency of these two types of firms.

This comparison leads to the result specified above: it does not allow us to establish whether the governance and organization of one of the two firms are more or less efficient with respect to those of the other (Section 5). As will be discussed in Section 6, to achieve a more precise overall result we would need to extend our model to analyse the financial aspects of the two firms. However, the formalization of this extended model would require complex descriptive and analytical work which goes beyond the limits of this paper. It will then be sufficient to show that the results achieved, albeit still not a solution, are interesting and lead to a number of more immediate extensions of our model.

2. The framework

As suggested in the *Introduction*, the main differences between capitalist and cooperative firms can be referred to different forms of ownership and governance. Furthermore, the economic literature has shown since the 1990s that different types of ownership and governance lead to different forms of corporate organization and control (Holmstrom and Milgrom 1991, Milgrom and Roberts 1992, Hansmann 1996, Rajan and Zingales 1998, Pagano and Roell 1998). Therefore, we pursue two objectives: we aim to describe the specific forms through which capitalist and cooperative firms seek to attain optimal levels of

organization and control with respect to their production processes, and define a relative measure of the efficiency degree achieved by these two firms with respect to such processes.

Besides reducing the two kinds of firms to a representative capitalist firm and a representative cooperative firm, our model makes use of the following assumptions.

First, we leave aside the problems of separation between firm ownership and firm management as well as the possible conflicts between majority and minority shareholders. The owner of our capitalist firm and (at least one of) the owners of our cooperative firm, who hold the residual rights of control over production outcomes, are also responsible for the firm's organization and the management of workers' activity. This implies that we neglect the possible problems of control which depend on different "agency relations".⁶ The capitalist firm is assimilated to the entrepreneurial initiative such that we neglect the form of public company, which leads to the agency problems between shareholders and *management* (Holmstrom and Milgrom 1991, Agrawal and Knoeber 1996, Ang *et al.* 2000), as well as the other forms of collective ownership, which lead to the agency problems between majority and minority shareholders (Jensen 1986, Shleifer and Vishny 1986, Burkart *et al.* 1997, Gomes and Novaes 2001, Cronqvist and Nilsson 2003). As entrepreneur, the owner also acts as the manager of the firm. On the other hand, we bring the cooperative firm back to the "purest" form of mutuality, that is to the organization of "production and work" in which all the workers are, *pro quota*, owners and share collectively the responsibility for their activities.⁷ Hence, in the capitalist firm, there is an owner-manager ($m=1$) and N workers and the only agency relation is between m and N . Conversely, in the cooperative firm, we neglect the fact that often in the real world

⁶ One of the early analyses of the various types of agency relations characterizing the firm is offered by Jensen and Meckling (1976). An agency relation is defined by a contract, according to which the individual entitled to set the terms of the contract and to offer these contractual terms on the market (that is, the "principal") delegates to other individuals (that is, the "agents") the implementation of activities which are crucial for the fulfillment of his/her objective function. The usual problem is that the "principal" has an incomplete or asymmetric set of information, such that she/he is unable (i) to design and to offer a contract which includes all the possible future events, and (ii) to exert a perfect and non-costly control on all the features and/or actions of the "agents". Hence, in order to solve his/her maximization problem, the "principal" has to design suitable contractual terms to give the agents (who act in their own interests) the right incentives to self-select themselves or their possible actions according to his/her preferred ranking. Moreover, the "principal" can find it convenient to implement imperfect and costly monitoring of the activity actually performed by the "agents". The costs, determined by the implementation of an *ex ante* and efficient incentive scheme, are termed agency costs; the costs, determined by the implementation of an imperfect *ex post* control, are termed monitoring costs. The relationships between shareholders and *management* or those between majority and minority shareholders as well as the relationships between lenders and borrowers may be interpreted as typical agency relations; another typical agency relation inside the firm is that between *management* and workers.

⁷ There are three different categories of cooperatives, at least in Italy: workers' cooperatives, users' cooperatives, and services cooperatives. The cooperative firms of "production and work" (*cooperative di produzione e lavoro*) belong to the first category. Generally speaking, from the analytical point of view, the workings of the different forms of cooperative firms in the three categories above can be reduced – directly or indirectly, and with different degrees of approximation – to the workings of the cooperative of "production and work". However, this general rule does not apply to consumers' cooperatives or to non-profit cooperatives. Ben-Ner (1986), Ben-Ner and Hoomissen (1993), and Mikami (2002 and 2003) elaborate stimulating, but not conclusive, attempts to reduce the behaviour of these two latter types of cooperatives to a common analytical framework. The topic of this paper, that is the comparison between the capitalist and the cooperative firm, justifies the exclusion of non-profit activities; here we extend this exclusion to consumers' cooperatives.

managers are not members of the cooperative. Therefore, we assume that there are N workers who are owners ($N = m$) and who select one of them, on the basis of her/his acquired experience, to play the role of *pro tempore* manager. Hence all the N workers are directly employed in the production process, but one of them is also a manager.

Second, let us start by excluding the problems and costs related to the monitoring of workers' activity (benchmark case); thus the two types of firms in question have the same production function. Each worker is endowed with a maximum capacity of effort ($\bar{e}_i = 1$; with $i = 1, 2, \dots, N$), and he/she receives a wage w which, in the benchmark case, corresponds to the maximum and optimal effort level (that is, $e_i = \bar{e}_i$). The stock of capital utilized in the production process by each firm is K .⁸ Therefore, in the benchmark case, the production function of the two firms is given by:

$$(1) Q^* = KN^\alpha \bar{e}_i = KN^\alpha$$

where $\bar{e}_i = 1$, Q^* is the optimal quantity produced under the above specified hypothesis, and α (with $0 <$

$\alpha < 1$) is the technical coefficient associated with labor such that $\frac{\partial Q}{\partial N} > 0, \frac{\partial^2 Q}{\partial N^2} < 0$

Since both firms operate in a market economy and are in competition, they have to comply with factors of efficiency and competitiveness. The capitalist firm satisfies these two constraints by pursuing the objective of maximizing its expected profits in the short term – that is, the difference between revenues and current production costs. The cooperative firm, instead, aims to guarantee stable employment and an adequate income for its members through the entire period of their working lives. Moreover, the cooperative firm aims at intergenerational equity, often pursued by means of the “free entry” principle for new, young and qualified members (Rey and Tirole 2007). This complex set of objectives implies the realization of an optimal growth rate in the long term. For this reason, even at the risk of excessive simplification, we assume that the cooperative firm maximizes the share of its current profits to be stocked as indivisible reserve, under the constraint of satisfying the mutuality principle by setting an amount of drawbacks which must be commensurate with the different forms of contribution made by each single member.⁹

⁸ For the sake of simplicity we assume that each firm fully consumes its available stock of capital in the current production process. Hence we eliminate all the problems related to inventories and depreciation.

⁹ Italian legislation regulating the activity of cooperative firms has changed dramatically in the last twenty years. Nevertheless, still today there is an obligation to transfer at least 30% of profits to a reserve which cannot be liquidated to members even in future periods (“indivisible reserve”). This obligation is compliant with the mutuality principle which is a crucial ingredient of governance of cooperative firms (cf. *infra*, footnote 19). Here we assume that the cooperative firm aims to maximize the share of profits which are assigned to reserves (from here on, assimilated to the indivisible reserve), since this same firm has the objective to keep growing in the long period. Therefore as the legal rule of 30% does not represent a binding constraint from the economic point of view, it can be overlooked in the maximization problem of the cooperative firm (see below). Moreover, our model excludes all the agency problems

The output of each of the two firms is the quantity (Q) of a given good, which is the only one produced in the economic system. The supply price of this good is normalized to 1. Apparently, to start its production process, the capitalist firm incurs just the direct labor costs (wN) since the entrepreneur (that is, the owner of the firm) already holds the required capital (K). The cooperative firm, instead, has to purchase the amount of capital required for its production process on the market. As we stated above, here we assume that each employee of the cooperative firm becomes an owner-member of this same firm by buying a share (K/N) of the capital K for a value equal to η ; where: $\eta = p_K K / N$, and p_K (from here on, just p) denotes the general price level of the capital goods. The sellers of the capital K are *rentiers*, that is ad hoc agents whose stock of goods and behavior are exogenous variables in our model. In principle, the seller of K could also be the entrepreneur of the capitalist firm who would thus forgo producing a portion of its output Q in order to play the role of *rentier* as well. For the sake of simplicity, here we drop this possibility. However, its mere evocation indicates that the capitalist firm (and not only the cooperative firm) has to bear, in addition to the labor cost, the cost of capital (that is pK ; see also footnote 8). In this respect, the cooperative firm incurs a direct cost of purchasing K on the market, while the capitalist firm incurs the “opportunity-cost” of its entrepreneur. Both these costs, which are equal, have to be included in the production costs.

In the benchmark case analyzed here, that is when workers are freely controlled and thus supply their optimal effort without costly monitoring, the expected profit of each of the two firms is the same and equal to:

$$(2) \pi_{cap}^* = \pi_{coop}^* = KN^\alpha \bar{e}_i - (wN + pK) = KN^\alpha - wN - pK$$

At the end of the production process, the owner of the capitalist firm has the right to take possession of the whole amount of profit made by the firm; each owner-member of the cooperative firm does not obtain,

between owners and managers by assumption, so that we can neglect the possibility that managers pursue opportunistic behavior under the screen of the objective function based on maximization of the reserve (cf. in this respect: Parnell 1995). On the other hand, current Italian legislation has put limits, albeit not so severe as in the past (see the so-called “new company law”), to the share and to the form of profits that the cooperative firm can assign to worker-members and to the different types of capital-members. Our model only refers to worker-members. In this respect the quantitative limits are determined by the Italian Civil Code itself: the distribution of profits over the law’s threshold must be decided by the firm’s assembly and must take the form of a drawback – that is, it has to be a function of the intensity of the mutualistic relationship, which each member holds towards the cooperative firm, and does not have to be proportional to the amount of capital given by each member. Here we do not refer to the legislative details. However, the drawback being a component of the mutuality principle, our attempt is to meet the substance of the legal rule by assuming that the share of the profits assigned to the worker-members is one of the binding constraints of the maximization problem of the cooperative firm.

instead, the portion $1/N$ of the realized profit but $1/N$ of the difference between this profit and the stocked reserve.

In our model the crucial problem consists in establishing whether (1) and (2) can be implemented when there is a standard problem of information asymmetry between owners and workers with respect to the effort supplied by the latter. In the literature, this kind of problem is solved by applying incentive schemes or imperfect monitoring schemes on worker activities (see for instance Spence 1974, Hart 1983, Guasch and Weiss 1987, Weiss 1990, Holmstrom and Milgrom 1994). Let us assume that, due to the presence of information asymmetry, the monetary wage is exogenously fixed (with $w < 1$), that is, it is determined independently of the actual effort supplied by workers. This means that there is no room for incentive schemes based on variable remunerations, and that the owners and/or managers have to resort to an imperfect monitoring scheme.

The easiest way to introduce such a scheme is to assume that, in both the firms in question, each worker obtains a utility U_i (expressed in an additive form) directly from his/her activity. This utility is equal to the difference between the monetary wage and a monetary measure of his/her effort, since the latter is equivalent to a disutility whose unit value is fixed by the coefficient ρ .¹⁰ For the moment, we just take into account that component of the utility which is directly related to the working activity also with respect to the cooperative firm. It follows that each worker, whose objective function is the maximization of his/her own expected utility, aims to supply the lowest effort given that the owners of the capitalist firm and the manager of the cooperative firm are unable to directly measure and control the above-mentioned effort – because of information asymmetries – and given that the monetary wage is exogenously fixed, as we assumed above. Equation (3) represents a simple formalization of what was just stated with respect to the representative worker i (with $i = 1, 2, \dots, N$):

$$(3) U_i = w - \rho e_i > \tilde{U}_i = w - \rho \bar{e}_i$$

for each $e_i < \bar{e}_i$; with $0 < \rho < 1$

Equation (3) implies that, with asymmetric information and without a monitoring scheme, it would be $e_i = 0$ at the limit: the lower the effort supplied with respect to the maximum level, the higher will be the utility of the worker and the lower will be his/her labor productivity. This prevents both firms from reaching the level of production and related profits determined by equations (1) and (2) in the case of symmetric information. The managers of the two firms thus find it worth using their resources to reduce the information asymmetries and to control (albeit imperfectly) the effort supplied by workers. In this respect, we assume that the entrepreneur of the capitalist firm as well as the owner-manager of the cooperative

¹⁰ Let us recall that the price level of the single good produced is normalized to 1. We also emphasize that each of the employees of the cooperative firm has a more complex utility function, which also includes an indirect utility as specified in Section 4.

firm have at their disposal a given amount of effort (normalized to 1) usable either to manage and organize the firm (e_m) or to monitor the workers' activity ($1 - e_m$)¹¹.

Since the entrepreneur is the sole owner of the capitalist firm, hence the only one who benefits from the entire amount of profits, he/she does not need any specific incentive to supply his/her maximum effort. That said, in principle entrepreneurs should be compensated with a remuneration s (with $s \geq w$) for their managerial activity; here we assume that $s = 0$ without any loss of generality and in order to emphasize the other differences from the benchmark case. The same assumptions apply to the effort of the manager of the cooperative firm. Even if he/she shares the ownership of the firm with the other members and hence just hold a portion K/N of the firm's capital, by construction of the model he/she is a worker-member and his/her income and interests are aligned to those of the other worker-members. Thus the problem becomes the allocation of the same and maximum amount of effort available for both managers between organization and monitoring.

The above considerations show that in (1) we established a relation between $\bar{e}_i (= 1)$ and Q^* , under the implicit assumption that the absence of information asymmetries implied $e_m = 1$. Instead, if we consider information asymmetries, $e_m = 1$ would imply $(1 - e_m) = 0$ and hence $e_i = 0$ and $Q = 0$. This means that, with information asymmetries, a share of the managerial effort must address the monitoring of workers (that is $e_m < 1$). As a consequence, *ceteris paribus* equation (1) would generate $Q < Q^*$, even if the monitoring effort of managers was fortuitously able to induce $e_i = \bar{e}_i = 1$. Usually, this monitoring effort is imperfect, such that $e_i < \bar{e}_i$ and, *a fortiori*, $Q < Q^*$. In any case, under information asymmetries, the actual e_i depends on e_m . Therefore equation (1) becomes:

$$(4) Q = KN^\alpha e_i e_m$$

with $0 < e_m < 1$; $e_i = e(1 - e_m)$, where $\frac{\partial e_i}{\partial e_m} < 0$; $\frac{\partial Q}{\partial e_m} > 0$, $\frac{\partial^2 Q}{\partial e_m^2} < 0$; $\frac{\partial Q}{\partial e_i} > 0$, $\frac{\partial^2 Q}{\partial e_i^2} < 0$.

Equation (4) represents a sort of simplified version of the production function OR type – that is an 'O-Ring function' (see Kremer 1993; Brada and Mendez 2009), in which the effort of the single worker influences total output by a multiplicative rather than an additive operator. This means that total effort is a total product of the single efforts instead of a summation of them. With respect to the original function OR, equation (4) does not establish a total product between the efforts of the single workers but rather between workers' effort ($N e_i$) and that share of the managerial effort (e_m) devoted to organization instead

¹¹ This assumption is unrealistic since, in our model, the worker-manager of the cooperative firm would have to work a 48-hour day in order to perform his/her whole set of tasks. Here, to directly compare the working of the cooperative firm and that of the capitalist one, we overlook this problem which could be solved by means of a modest complication in the formal structure of our model. Let us add that, according to the literature, we will indicate the managerial effort to manage and organize the firm as organizational effort.

of monitoring. Hence, the optimal allocation of the managerial effort between e_m and $1 - e_m$ has to be determined.

To simplify the solution of this problem, we assume that e_i is a stochastic increasing function of the managerial effort allocated to monitoring. In particular, with δ ($0 < \delta < 1$) being the coefficient of the related linear function, we have:

$$(5) e_i = z_{m,i} \delta (1 - e_m) + (1 - z_{m,i}) e'_i$$

with $\frac{\partial e_i}{\partial (1 - e_m)} > 0$; where $z_{m,i}$ indicates the probability that a higher monitoring effort by manager m

increases the level of effort of worker i , and e'_i indicates the minimum threshold (> 0) of the latter effort

which has a probability $(1 - z_{m,i})$ of evading monitoring (with $0.5 < z_{m,i} < 1$; $\frac{\partial z_{m,i}}{\partial e_m} < 0$).¹²

For the sake of simplicity, we assume that e'_i is constant and we denote $M = (1 - z_{m,i}) e'_i$ (with $M \rightarrow 0$ when $z_{m,i} \rightarrow 1$). Equation (5) can therefore be rewritten as follows:

$$(5bis) e_i = z_{m,i} \delta (1 - e_m) + M$$

Equation (5bis) implies that the production function of the two firms, expressed by equation (4), and the worker's direct utility, expressed by equation (3), can be respectively re-written as:

$$(6) Q = KN^\alpha [z_{m,i} \delta (1 - e_m) + M] e_m$$

$$(7) U_i = w - \rho [z_{m,i} \delta (1 - e_m) + M]$$

with $\frac{\partial Q}{\partial e_m} > 0$, $\frac{\partial^2 Q}{\partial e_m^2} < 0$; $\frac{\partial U_i}{\partial e_m} > 0$, $\frac{\partial U_i}{\partial (1 - e_m)} < 0$

3. The model: the capitalist firm

Given the framework described in the previous section, it is possible to solve the maximization problems which express the respective objective function of the two firms in question.

We start from the capitalist firm reduced to an entrepreneurial initiative. It is assumed that this firm pursues the maximization of its short-term expected profit, that is the maximization of the difference between the revenues and the monetary costs of its current production. The available capital (K) is given and fully depreciated in a single production process; therefore the technical coefficient of production is equal to: $k = K / N$. The maximization problem is then reduced to a dual choice: the number of labor units

¹² In our model, the condition ($0.5 < z_{m,i}$) is an assumption required to obtain economically significant results. However, it is reasonable to apply a kind of Shapley rule to the expected impact of imperfect monitoring.

to be employed (with $N \leq N_s^{13}$), and the amount of managerial effort (e_m) which has to be allocated to the firm's organization rather than to monitoring workers' activity. We therefore have to find the values of N and e_m which maximize the expected profits of the capitalist firm, given that the wage (w) is exogenously determined and under the constraint that the workers' expected utility must be greater or at least equal to the reserve utility (fixed, for simplicity, equal to 0^{14}). In the case of the capitalist firm, the direct expected utility of each worker (see the equation 7 above) coincides with his/her expected utility.¹⁵

The constrained maximization problem is given by:

$$(8) \quad \max_{N, e_m} Q - (wN + pK) = KN^\alpha [z_{m,i} \delta (1 - e_m) + M] e_m - (wN + pK)$$

$$s.t. : U_{i, cap} = w - \rho [z_{m,i} \delta (1 - e_m) + M] \geq 0$$

The Lagrangian becomes then:

$$L = KN^\alpha [z_{m,i} \delta (1 - e_m) + M] e_m - (wN + pK) + \lambda \{ w - \rho [z_{m,i} \delta (1 - e_m) + M] \}$$

To fix the optimal value of N and e_m , we need to build up a system of equations that express the first order conditions.¹⁶ One of the functions to be maximized relates to the amount of the optimal managerial effort dedicated to the firm organization:

$$\frac{\partial L}{\partial e_m} = 0$$

From this derivative we obtain the value for the Lagrangian coefficient:

$$(9) \quad \lambda = \frac{2KN^\alpha z_{m,i} \delta e_m - M - KN^\alpha z_{m,i} \delta}{\rho z_{m,i} \delta}$$

Another function to be maximized relates to the optimal choice concerning the amount of labor units (N):

$$\frac{\partial L}{\partial N} = 0.$$

This derivative leads to:

$$(10) \quad N = \left[\frac{\alpha K [z_{m,i} \delta (1 - e_m) + M] e_m}{w} \right]^{\frac{1}{1-\alpha}}$$

¹³ N_s indicates the maximum amount of labor units available in our economic system and offered at wage w . Strictly speaking, the condition $N \leq N_s$ would have to be incorporated as a constraint in the following maximization problem. In order to avoid a pointless complication, we assume that this constraint is always met as a strict inequality, that is, it is never binding.

¹⁴ It must be noted that such a simplification cannot be extended to the case of the cooperative firm.

¹⁵ This condition too does not apply to the cooperative firm.

¹⁶ The concavity of the production function, specified in equations (1) and (4) (see above), makes it unnecessary to determine the second order conditions for the constrained solution of problem (8).

The third and last first order condition relates to the maximization of L with respect to the coefficient λ , that is:

$$\frac{\partial L}{\partial \lambda} = 0$$

From this derivative we obtain the optimal value of the managerial effort to be allocated to firm organization rather than to monitoring workers:

$$(11) \quad e_m = 1 - \frac{w - \rho M}{\rho z_{m,i} \delta}$$

with $w - \rho M < \rho z_{m,i} \delta$.

It is possible to offer an economic interpretation of the equilibrium conditions which derive from the solution of the constrained maximization problem.

The first equilibrium equation (10) determines the optimal level of employment in the capitalist firm as a function of labor productivity which, in turn, depends on the managerial effort devoted to firm organization and on the monetary wage. Equation (10) can also be rewritten as:

$$(10bis) \quad \frac{\alpha KN^{\alpha-1} [z_{m,i} \delta (1 - e_m) + M] e_m}{w} = 1$$

Equation (10bis) underlines that the optimal amount of labor units to be employed in a capitalist firm is the amount that equalizes the marginal revenue to the marginal cost. The marginal revenue is equal to the marginal productivity of labour (that is, $\alpha KN^{\alpha-1} [z_{m,i} \delta (1 - e_m) + M] e_m$), given the normalization to 1 of the price of the produced good; the marginal cost is equal to the unit cost of labor (that is, w).

The second equilibrium equation (11) determines the optimal amount of managerial effort to be spent organizing the firm. This equation can also be written as:

$$(11bis) \quad 1 - e_m = \frac{w - \rho M}{\rho z_{m,i} \delta}$$

Equation (11bis) shows that the optimal amount of managerial effort to be spent monitoring workers depends, directly, on the wage w and, inversely, on the following variables: the unit coefficient of the disutility associated to workers' effort (ρ), the workers' possibility to elude the impact of managerial monitoring (M), the reaction parameter of workers' effort to managerial monitoring itself (δ), and the probability ($z_{m,i}$) that higher managerial monitoring effort could increase workers' effort.

The economic interpretation of the direct relationship between w and $(1 - e_m)$ becomes obvious if we consider that, in our model, the monetary wage is exogenously determined. Every exogenous increase of w implies greater managerial effort spent monitoring workers' activity, since the latter are called upon to offer a higher actual effort in order to compensate for their wage increase. It is also evident that an increase in the reaction parameter δ or in the probability of a positive reaction by workers $z_{m,i}$ to

managerial monitoring allows – *ceteris paribus* – to obtain adequate workers' effort with a lower managerial monitoring effort; for the owners, therefore, it becomes worth allocating more effort to the organization of the firm.

The economic interpretation of the inverse relations between ρ and $(1 - e_m)$ and between M and $(1 - e_m)$ is less evident. Apparently, these relations should be direct and not inverse. If there is an increase in workers' disutility at any given effort or if there is an increase in workers' probability to elude the impact of monitoring beyond the minimum effort threshold, these same workers will have an incentive to decrease their effort at least till this threshold. As a consequence, there would have to be greater managerial monitoring effort in order to avoid an inadequate level of workers' effort. However, both these relationships could derive from failures in the organization of the production activities and/or in monitoring; and every increase in $(1 - e_m)$ reduces the managerial effort for the organization of the firm (e_m). It may thus be plausibly hypothesized that, if increases in $(1 - e_m)$ have a limited positive impact on e_i due to the high value of ρ and/or M , it could become worth reducing the managerial effort devoted to monitoring whenever there are further increases in workers' disutility or in workers' probability of avoiding the impact of monitoring. Hence there are two opposite tendencies relating ρ and M to $(1 - e_m)$. Equation (11bis) shows that the second tendency dominates the first.

Equation (11) can be rewritten differently from (11bis), that is as:

$$(11ter) \quad e_i = \frac{w}{\rho}$$

Equation (11ter) suggests a much more intuitive economic interpretation than (11bis): it reproduces a typical condition of the theory of efficiency wages.¹⁷ The worker fixes his/her equilibrium effort in order to make it equal to the marginal increase in his/her utility (expressed by wage) and the marginal increase in the cost of the supplied effort (expressed by ρ).

Beyond their variations and their specific economic interpretation, the two equilibrium equations (10) and (11) show an important basic element. In the capitalist firm examined, the entrepreneur incurs a cost to determine the optimal level of employment and the optimal amount of monitoring workers' activity: in order to achieve this result, the entrepreneur has to limit his/her effort allocated to the organization of the firm, which would increase its productivity and consequently the amount of output produced. Hence the activity of the capitalist firm is actually compelled to make a *trade-off*: given that the entrepreneur has an

¹⁷ This approach analyzes the positive but decreasing impact that wages increases have on the dynamics of labour productivity, and it shows that the minimization of the labor cost per unit of output is achieved at levels of w which fall between a minimum and maximum level (cf. Solow 1979). Solow's results have been refined and extended thanks to the examination of the possible links between efficiency wages and adverse selection mechanisms (cf. Weiss 1980) or moral hazard mechanisms (cf. Shapiro and Stiglitz 1984). Here it is sufficient to note that, according to this approach, firms do not aim to minimize the level of w but find it convenient to increase wages up to the level which coincides with the minimum labor cost per unit of output.

available amount of effort normalized to 1, she/he has to allocate this amount between monitoring worker and organizing the firm. If the entrepreneur had been able to check on the workers effort without a costly monitoring effort, these workers would have been forced to supply their maximum effort and the entrepreneur would have had the possibility to concentrate all efforts on firm's organization. However, the presence of information asymmetries makes this hypothetical equilibrium (partly described by equation (1) above) impossible to attain. Hence the optimal equilibrium of N and e_m , described by equations (10) and (11), is always dominated by the equilibrium that could be achieved, in the absence of information asymmetries, between entrepreneur and workers in terms of the effort supplied by the latter.

Analysis of the activity of the cooperative firm, offered in the next section, aims to establish the cost of the *trade-off* described above and of other possible costs incurred by this kind of firm. It will then become possible to compare the relative efficiency of the two types of firms with respect to managers' monitoring of workers' effort and managers' organizational effort as well as other possible costs.¹⁸

4. The model: the cooperative firm

To complete the analysis of the variables determining the choices of worker effort in the cooperative firm, three new factors have to be introduced.

The first factor was partly examined in section 2. To become an owner-member of the cooperative firm, each worker has to buy on the market a share of the capital k (with $k = K/N$) whose value is equal to η (with $\eta = pK/N$; where p indicates the general price level of the capital goods). To simplify the following formalization, we consider $P \equiv pK$ such that $\eta = P/N$. As we stated above, the total cost of the purchase of K (that is P) represents one of the production costs of the cooperative firm and so it enters its profits' function (see equations (2), (4) and (5) above):

$$\pi_{coop} = KN^\alpha [z_{m,i} \delta (1 - e_m) + M] e_m - wN - P$$

On the other hand, having been borne by each worker of the firm, this cost can also represent a cost-opportunity for the workers themselves. In this respect, let us assume that there is an alternative allocation of η able to assure a riskless rate of return equal to r . The utility function of the single worker of the cooperative firm must then have a value at least equal to that of the reserve utility \bar{U}_i fixed by the alternative return r :

$$(12) \bar{U}_{i,coop} = rpk \equiv r \frac{P}{N}$$

with $0 < r < 1$.

¹⁸ The comparison will be made in Section 5 below.

The second factor is based on another aspect that we have highlighted several times: in the cooperative firm workers are also owners, so that they take possession of the distributed profits. Nevertheless, we have to remember that this kind of firm is characterized by the mutuality principle, and that a fundamental component of this principle is based on the fact that the cooperative firm allocates most of its realized profits to a reserve fund and then to drawbacks.¹⁹ Indeed, since the cooperative firm has the objective of fulfilling optimal long-term growth, it aims to maximize the share of its profits assigned to the reserve fund, under the constraint of assuring drawbacks compatible with the utility function of their worker-members. Let φ be the share assigned to the reserve (where: $0 < \varphi \leq 1$); the remaining part of these profits, distributed between the members of the cooperative firm also in the form of drawbacks is then equal to $(1 - \varphi)$. It follows that, for the cooperative firm, φ is to be added to e_m as the choice variable.²⁰ On the other hand, the expected utility function of each worker-member is not reducible anymore to its direct utility (see equation (7) above) but has to be integrated with its share of profits $(1 - \varphi) \frac{\pi_{coop}}{N}$. In a first approximation we would then have:

$$U_{i,coop} = w - \rho [z_{m,i} \delta (1 - e_m) + M] + (1 - \varphi) \left\{ KN^{\alpha-1} [z_{m,i} \delta (1 - e_m) + M] e_m - \left(w + \frac{P}{N} \right) \right\}$$

Not even the previous expression represents, as yet, the complete form of the expected utility function of each member of the cooperative firm. Indeed, this expression has to be integrated with another component of the mutuality principle that has been treated by Sen (1966) in terms of '*social consciousness*'. '*Social consciousness*' has been disregarded in the representation of the cooperative firm, with rare exceptions, (for instance: Panagariya 1980; Kremer 1993), even if cooperative firms have an

¹⁹ The mutuality principle represents the crucial feature of cooperative governance. This principle is based on at least four elements: (i) the rule of "one head, one vote", (ii) limits to the remuneration of that part of capital possibly contributed by non worker-members, (iii) the choice and constraints to attribute a significant share of the yearly profits (net of the remuneration of the ordinary capital) to reserves, and (iv) the choice of transforming the share of the remaining net profits into drawbacks for worker-members. Here we assume that the total amount of capital has given by worker-members, so that there is no problem of remuneration of the ordinary capital. We also assume that, beyond legal obligations, the mutuality principle *lato sensu* can be reduced to element (iii) and to the consequent indivisibility of the cooperative firm's reserves. For the allocation of a significant portion of profits to reserve and the indivisibility of the latter introduce the distinction between: maximization of the profits acquired by the owners (maximization of the "subjective gain"), which cannot be dominant in the governance of the cooperative firm, and maximization of the firm's growth (maximization of the "objective gain"), which is a pivotal point of this governance since it gives substance to the long-term guideline.

²⁰ On comparison with the maximization problem of the capitalist firm, we thus have that φ replaces N . If we refer to the tradition initiated by Ward (1958), it may appear appalling that the cooperative firm does not include the employment level between its choice variables. The point is that, in our model, we list the short-term employment level among the exogenous variables. This level coincides with the number of owner-members, that is with the number of the purchasers of a share of the firm's capital; and it would be analytically too complex to determine the number of worker-members and owner-members as endogenous variables. By contrast, the long-term employment level is indirectly included in the choice variables of the cooperative firm, since it is approximated by φ itself (cf. above, section 2). Moreover, as will become clear in the following, N indirectly enters the utility function of workers of the cooperative firm.

ownership structure and an organization that incentivizes solidarity among workers.²¹ In our model, we can refer to the concept of ‘social consciousness’ by assuming that the utility, and hence the effort of the single worker, also depends on the utility obtained by the other workers of the cooperative firm. This means that the utility of each member, more than being a direct function of the wage received and of the distributed profits and drawbacks as well as an inverse function of the effort supplied, is also positively influenced by the utility accomplished by the other members of the cooperative firm thanks to their working activity. γ_0 indicates the coefficient that evaluates that positive influence. Henceforward, γ_0 will be termed the ‘social consciousness’ coefficient. Furthermore, it must be recalled that all the workers of the cooperative firm receive the same wage, exogenously fixed, and the same share of profits. The expected utility of the single worker of the cooperative firm then becomes:

$$(13) U_{i,coop} = w - \rho [z_{m,i} \delta (1 - e_m) + M] + (1 - \phi) \frac{\pi_{coop}}{N} + \gamma_0 (N - 1) \{w - \rho [z_{m,i} \delta (1 - e_m) + M]\}$$

with $0 < \gamma_0 < 1$

Equation (13) can be rewritten as:

$$(14) U_{i,coop} = \gamma \{w - \rho [z_{m,i} \delta (1 - e_m) + M]\} + (1 - \phi) \{KN^{\alpha-1} [z_{m,i} \delta (1 - e_m) + M] e_m - (w + pk)\}$$

with $\gamma = 1 + \gamma_0 (N - 1)$.

Equation (14) is based on the fact that γ also depends on the employment level. From the economic point of view, it underlines that the utility of the worker-owners of the cooperative firm is also a direct function of the number of its employees. ‘Social consciousness’ (γ_0) and the other elements of the expected utility function being equal, each of the worker-owners of a cooperative obtains a greater utility if his/her firm has a higher employment level. In this sense, the objective of the cooperative to optimize its own long-term growth can also be interpreted as the goal of maintaining high levels of employment in the long term (see also footnote 20).

Given these considerations, the problem of the constrained maximization problem of the cooperative firm is given by:

²¹ In Sen's model (1966), the agents are represented by ‘households’. Each household not only maximizes its utility (calculated by labor income and free time), but also includes the utility of other households in its preferences. This ‘social consciousness’ (S), which is defined in the interval $[0 - 1]$, affects workers’ effort. In particular, if S is equal to 1 - that is, if each household considers the utility of other households as important as its own, workers’ effort will achieve the optimal level independently of income distribution. On the contrary, if S becomes less than 1 - that is, if each household considers its utility more valuable than that of other households, workers’ effort will reach a suboptimal level. Sen’s analysis has been used in some papers devoted to the analysis of the working of the Israeli Kibbutz (Guttman and Schnytzer 1989; Fabella 2000).

$$(15) \quad \begin{aligned} & \max_{\phi, e_m} \phi \left\{ KN^\alpha [z_{m,i} \delta (1 - e_m) + M] e_m - (wN + pK) \right\} \\ & s.t. : U_{i,coop} = \gamma \left\{ w - \rho [z_{m,i} \delta (1 - e_m) + M] \right\} + (1 - \phi) \left\{ KN^{\alpha-1} [z_{m,i} \delta (1 - e_m) + M] e_m - (w + pk) \right\} \geq r \frac{P}{N} \end{aligned}$$

where: $\gamma > 1$ and $0 < e_m, \delta, w, \rho, \varphi, z_{m,i} \leq 1$

Therefore the Lagrangian function is:

$$L = \phi \left\{ KN^\alpha [z_{m,i} \delta (1 - e_m) + M] e_m - (wN + pK) \right\} + \lambda \left\{ \gamma \left\{ w - \rho [z_{m,i} \delta (1 - e_m) + M] \right\} + (1 - \phi) \left\{ KN^{\alpha-1} [z_{m,i} \delta (1 - e_m) + M] e_m - (w + pk) \right\} - r \frac{P}{N} \right\}$$

One of the first order conditions concerns the maximization of L with respect to the reserve to be stored:

$$\frac{\partial L}{\partial \phi} = 0$$

It follows that the value of the Lagrangian coefficient is:

$$(16) \quad \lambda = N$$

Offering formal confirmation of what is already realized by φ and equation (14), equation (16) proves that the employment level remains a crucial factor in the operating of the cooperative firm also in terms of our model. Indeed, if considered in the short term as an exogenous variable, N represents a constraint with respect to the indirect utility that each worker of the cooperative firm benefits from the utility of other worker-members; furthermore, in the long term, N is approximated by one of the choice variables (φ).

Once the value of the Lagrangian coefficient is determined, we can specify a second condition of the first order by maximizing L with respect to the amount of the management effort allocated to the organization of the cooperative firm (e_m):

$$\frac{\partial L}{\partial e_m} = 0$$

Given equation (16), we determine the optimal level of e_m :

$$(17) \quad e_m = \frac{N^{1-\alpha} \gamma \rho z_{m,i} \delta + K(M + z_{m,i} \delta)}{2Kz_{m,i} \delta}$$

The last first order condition concerns the derivative of L with respect to the Lagrangian coefficient λ :

$$\frac{\partial L}{\partial \lambda} = 0$$

It follows that the optimal value of the profits share to be stored as reserve is:

$$(18) \quad \phi = \frac{\gamma \left\{ w - \rho [z_{m,i} \delta (1 - e_m) + M] \right\} + KN^{\alpha-1} [z_{m,i} \delta (1 - e_m) + M] e_m - w - \frac{P}{N} - r \frac{P}{N}}{KN^{\alpha-1} [z_{m,i} \delta (1 - e_m) + M] e_m - w - \frac{P}{N}}$$

Let A denote the profit obtained by the cooperative firm for each employee, B the monetary wage received by each worker net of the effort supplied, C the opportunity cost borne by the worker him/her self to become member of the firm. Then:

$$A = KN^{\alpha-1} [z_{m,i} \delta (1 - e_m) + M] e_m - w - \frac{P}{N},$$

$$B = \gamma \left\{ w - \rho [z_{m,i} \delta (1 - e_m) + M] \right\},$$

$$C = r \frac{P}{N}$$

It follows that equation (18) can be rewritten as:

$$(18bis) \quad A(1 - \varphi) + B = C.$$

Equation (18bis) indicates that the cooperative firm finds it optimal to store as reserve that share of the realized profits which makes the additional utility obtained by the owner-worker and his/her reserve utility equal.

The solution of the constrained maximization problem of the cooperative firm thus leads to the determination of the two equilibrium equations (17) and (18). The latter equations show that, as in the case of the entrepreneur in the capitalist firm, also the worker-owners of the cooperative firm have to hold up a trade-off in order to determine the optimal share of the profits to be stored as reserve and the optimal level of monitoring effort to be allocated to workers' activity. If workers' effort had been equal to 1 even in the absence of monitoring, in the cooperative firm the manager would have maximized her/his organizational effort. However, the presence of information asymmetries makes this hypothetical equilibrium (partly described by the equation (1), before) unattainable. Hence, in his/her role as manager *pro-tempore*, one of the worker-members is obliged to limit the effort allocated to organizing the firm in order to monitor the remaining workers. This limitation has a negative impact on the productivity and output of the cooperative firm. Moreover, if worker-owners gave up their rights to take possession of a positive share of the profits, the cooperative firm would employ all its resources for long-term growth and employment. However, the opportunity cost borne by worker-members to buy their individual share of capital, does not allow for this kind of equilibrium. Therefore, as owners, workers limit the potential of long-term growth of the firm to take possession of profit shares also in the form of drawback.

As a result, the optimal equilibrium of φ and e_m , described by equations (17) and (18), is nevertheless lower than that which would be achieved in the absence of information asymmetries with respect to the workers' effort and in the absence of positive costs of becoming worker-members.

5. A comparison between the two kinds of firm

The analysis, developed in the two previous sections, shows that a comparison between the relative efficiency of the capitalist and cooperative firms in pursuing their specific objective functions cannot be immediately established. In order to take a step forward, it may be useful to specify the influence exercised by some independent variables on the values of e_m and φ in the case of the cooperative firm, and to make a comparison – where possible – between the results thus obtained and the case of the capitalist firm.

Let us start from equation (17), here reproduced with just a simple manipulation:²²

$$(17bis) \quad 1 - e_m = \frac{1}{2} - \frac{N^{1-\alpha} \gamma \rho}{2K} - \frac{M}{2\delta z_{m,i}}$$

Equation (17bis) shows that, as happens in the capitalist firm, in the cooperative firm the optimal amount of monitoring effort spent by the temporary manager has an inverse relation with the following variables: the unitary coefficient of the monetary disutility related to the effort of workers (ρ); the probability of the same workers to elude managerial monitoring (M); the relations between this probability and - respectively - the reaction parameter of workers' effort to monitoring (δ) and the probability ($z_{m,i}$) that a higher monitoring effort increases workers' effort; the parameter (γ), which is a direct function of the 'social consciousness' (γ_0).²³

These relations show that in the cooperative firm, as in the case of the capitalist firm, it is convenient to increase the organizational effort of the manager and to decrease – consequently – his/her monitoring effort whenever the positive impact of $(1 - e_m)$ on e_i is low due to the high value assumed by ρ and/or M .²⁴ Moreover, as in the case of the capitalist firm, the inverse relation between M and $(1 - e_m)$ is reinforced by the impact of δ and $z_{m,i}$ which, having a value between 0 and 1 and being placed at the denominator, increase the value of the relative ratio. However, equation (17bis) shows that in the cooperative firm, unlike what happens in the capitalist firm, the optimal amount of $(1 - e_m)$ does not depend on wages (w) but depends inversely on γ , that is, on the parameter of 'social consciousness'. In order to compare the resulting monitoring cost incurred by the management to give the workers the incentive to perform that effort which maximizes the objective function of the two kinds of firm, it is then necessary to concentrate on this difference.

²² Differently from equation (17), in the equation (17 bis) the dependent variable is represented by the managerial effort of monitoring instead of by the managerial effort of organizing the firm.

²³ See also equations (13) and (14). Moreover, it must be noted that γ and γ_0 can be assimilated without any distortion in the analysis as long as the topic of employment is left aside.

²⁴ In this respect, what has already been stated in relation to the capitalist firm remains valid (cf. above, section 3).

First of all it has to be remembered that, in the capitalist firm, $(1 - e_m)$ is a direct function of w . By contrast, in the cooperative firm increases in the degree of altruism, which is a component of the utility function of the single worker-owners and is now expressed by parameter γ , involve a reduction of $(1 - e_m)$. It is easy to find a possible economic justification for this inverse relation between parameter γ and $(1 - e_m)$: the increase in utility that each worker gets from the rise in the utility of his workfellows and hence from the rise in output produced by the cooperative firm, albeit at the cost of greater individual labor effort, pushes every worker to increase his/her effort and to react more positively to the monitoring effort made by the manager. This means that, with respect to the capitalist firm, in the cooperative one the parameter of 'social consciousness' reduces the rise in the monitoring effort, imposed by a given increase of w . The result is that, *ceteris paribus*, in the cooperative firm the optimal level of managerial monitoring is lower with respect to the capitalist one.

Another way to reach the same conclusion is by considering the parameter γ in a perspective which is slightly different from that suggested by Sen (1966) but which is consistent with the assumption of interdependence among workers' utilities in the cooperative firm. The ownership structure and the organization of this kind of firm make it convenient for the single workers to stimulate and control the efforts of their colleagues. It is a behavior which has long been studied in the economic literature and which has been denominated "peer monitoring".²⁵ The informal and decentered nature of this form of monitoring minimizes firm's costs (here considered equal to 0), without affecting its efficiency. As a consequence, in the presence of efficient "peer monitoring" and other things being equal, a lower managerial monitoring effort is sufficient to obtain an optimal effort by workers. Let us note that the typical ownership structure of the cooperative firm and the related utility function of its single workers stimulate "peer monitoring", such that the optimal monitoring effort can be further reduced. Each worker, holding an ownership share of the cooperative firm, finds it convenient to make the relative production process as efficient as possible; he/she thus has an incentive to control that his/her colleagues would not shirk their working effort and to develop a solidarity relation with each of them.

These results are reinforced by the fact that the cooperative firm does not need to have recourse to additional monitoring in the case of exogenous increases in employment. By contrast, equation (17bis) shows an inverse relationship between N and the amount of monitoring; and, if the distinction between γ and γ_0 is reintroduced (see footnote 23), equation (14) displays a direct relation between N and γ . Both the equations thus show that, if the cooperative firm increases its employment, there is a decrease in the amount of monitoring required by the manager in order to obtain optimal workers' effort. The economic justification of this statement is a logical consequence of the previous considerations: as we stated above,

²⁵ This concept was used by Stiglitz (1990) to analyse the working of the credit market and by Arnott and Stiglitz (1991) to analyse that of the insurance market. Moreover, Spagnolo (1999) referred peer monitoring to firms' organisation. To analyse the papers which applied the concept of peer monitoring to the cooperative firm, see Alessandrini (2012).

(see Section 4), if N increases, *ceteris paribus* there will also be an increase in the utility of the single worker and/or stronger motivation to perform peer monitoring.

Here it is important to underline that the opposite holds true for the capitalist firm. As indicated in equations (10) and (11bis) (see section 3), an increase in w (that is, in the optimal level of working effort) implies an increase in the employment level as well as the required amount of managerial monitoring. In this case, too, the economic justification is evident: if N increases, entrepreneurs will have greater difficulty controlling each worker's effort and then will have to increase their monitoring effort. However, the increase in N often comes with an increase in the organizational complexity of the capitalist firm. If this occurs, unlike the cooperative firm, the capitalist firm will pay for each increase of N with an increase in the cost of the trade-off: the allocation between the optimal effort level which the entrepreneur has to allocate to monitoring and to organization becomes further sub-optimal.

What we stated above leads to an initial conclusion. If comparison between the capitalist firm and the cooperative firm was limited to the problem of workers' control, we would be able to give a clear-cut answer to the question which is at the core of this paper: in a monitoring model of working activity, the cooperative firm pursues its objective function more efficiently than the capitalist firm. 'Social consciousness', that is, solidarity among cooperative workers, explains this relative advantage. However, what has been disregarded until now is the other variable that the cooperative firm aims to maximize: the share of profits (φ) stored in the indivisible reserve. To complete our analysis and the comparison with the capitalist firm, we thus have to examine the equation (18), here rewritten as (18bis) by stressing the variable φ :

$$(18\text{ter}) \quad \varphi = \frac{A + B - C}{A} \equiv 1 + \frac{B - C}{A}$$

where:

$$A = KN^{\alpha-1} [z_{m,i} \delta (1 - e_m) + M] e_m - w - \frac{P}{N},$$

$$B = \gamma \left\{ w - \rho [z_{m,i} \delta (1 - e_m) + M] \right\},$$

$$C = r \frac{P}{N}$$

As regards the notation, A stands for the profits of the cooperative firm made per employee, B the monetary wage collected by each worker net of the effort supplied, and C the opportunity cost borne by the worker himself to become member of the firm (with $B < C$).²⁶

²⁶ The assumption ($B < C$) can be justified by considering that, in our model, each worker-member of the cooperative firm would not find the remuneration of that firm convenient if his/her income was mainly based on wages. ($B < C$) indicates that the difference between the reserve utility of the worker-member of the cooperative firm and his/her wage income is compensated by participation in the distributed profits.

The equation (18ter) shows that the share of the stored profits is a direct function of the wage of each worker, net of the monetary value of the disutility deriving from the worker's effort actually supplied, but an inverse function of the profits realized per worker and of the opportunity cost borne by workers themselves to become members. Increases in the net wage raise the utility of each worker and erode the profits of the cooperative firm; the latter can, however, decrease the share $(1 - \varphi)$ of these profits attributed to worker-owners in the form of drawbacks. On the other hand, to raise the amount of profits realized per employee, the firm in question has had to increase productivity and hence the effort actually supplied by all the workers. It is then understandable that the latter want to be compensated for their greater disutility with an increase of $(1 - \varphi)$. It is finally expected that, if each worker can obtain higher financial returns outside the firm, he/she will choose to become a member only if $(1 - \varphi)$ increases.

Equation (18ter) thus shows that, in the cooperative firm, there is always a trade-off between the degree of efficiency of the current production process and the maximization of long-term growth. Furthermore, this same equation emphasizes that, if potential worker-members have a better opportunity of risk-free investment in the financial market, there is a further impediment to that growth.²⁷ The various problems originating from such constraints do not only directly limit the rate of growth of the cooperative firm in the long term, but they also weaken the possible virtuous circle between the increases in the employment level and the growth rate. It could be maintained that similar constraints also affect the capitalist firm. However this does not hold in our model. By assumption, the entrepreneur makes enough capital so as to generate every production process available to his/her firm.

The comparison between the behaviour of the capitalist firm and that of the cooperative firm in pursuing their specific objective functions is thus much less clear-cut than it appeared from equation (17bis) alone. Indeed, our conclusion is that the relative efficiency of the two kinds of firm depends on whether monitoring costs prevail over financial costs or the other way round.

6. Conclusions: some hint about the financial aspects

The results achieved by our model which dealt with the problem of the monitoring workers' activities and the finance of capital in a capitalist firm and a cooperative firm, both characterized by some economic specificities and institutional elements, can be summarized in the following terms.

From the analytical point of view, the part dedicated to managerial monitoring of the working activity is the most developed. This part proves that, in the presence of information asymmetries about the actual effort offered by each worker, the cooperative firm requires less monitoring to achieve the optimal level of worker effort. Being also owners of the firm and choosing the person responsible for management

²⁷ In our model the cooperative firm does not have direct access to financial markets, and hence it does not obtain any advantage from the improved efficiency of these markets. Our cooperative firm is financed just by its worker-members (see also section 6).

functions inside their circle, cooperative workers develop relations based on solidarity and forms of peer monitoring which reduce monitoring costs. Consequently, the manager of the cooperative firm can devote more of his/her effort to organizational activity which increases the efficiency of the production process. Hence, with respect to working effort and to the related organization of the production process, governance in the cooperative firm is more efficient than in the capitalist firm.

However, we have the opposite result as regards the aspects analyzed in the less developed part of our model, that is the purchasing cost of capital in the two kinds of firm. Governance itself of the cooperative firm, which plays a key positive role in the production process once the necessary stock of capital is obtained, causes inefficiencies with respect to the modalities of purchasing that same stock before the beginning of every production process. Given that every worker of the cooperative firm can become a member only if he/she buys a share k of the capital in the market (where $k = K/N$), it follows that his/her financial effort has to be remunerated with a greater utility related to his/her working activity or to the allocation of a share of the profits made by the firm. Therefore the financial constraints to the purchase of K reduce the production efficiency that the cooperative firm would achieve if only managerial monitoring and the consequent organizing effort are considered. In addition, such constraints represent an obstacle to achieving an optimal rate of long-term growth for the cooperative firm and benefiting from the related virtuous circle between increases in the level of employment and growth rate. Such inefficiencies and constraints are not present in the capitalist firm: even considering the incurring of an opportunity cost, the entrepreneur always makes the capital stock K available for her/his firms in line with the pursuit of her/his own objective, namely maximization of current profit.

The advantages of the capitalist firm with respect to the cooperative thus appear to be connected with the financial resources for the purchase of capital K . In the real world, these advantages tend to be less effective than what emerges from our model. For instance, the operational mode adopted in the Italian production system, which is concentrated on small and micro firms (which come close to the entrepreneurial organization we examined), has often been stigmatized as “capitalism without capital”:²⁸ financial constraints, resulting from the family assets of entrepreneurs who are reluctant to share the control of their firms with others outside the same family and to have recourse to the regulated capital market or – even – to bond debt, and who mistrust external managers, drastically limit the growth of their successful activities and/or accentuate their dependence on the banking sector. On the other hand, some kinds of cooperative firms (most of all, consumer cooperatives) contract large amounts of stable low-cost debt (so stable as to come close to capital funding). This particular form of debt consists of members'

²⁸ The peculiar bank-oriented working of the Italian financial market is reproduced through time by the limited amount of finance that the large majority of Italy's small and very small firms and a significant part of its medium-sized firms obtain from financial sources other than self-finance and bank loans.

loans.²⁹ Moreover, a large number of Italian cooperative firms have conditions of access to banking loans and other financial assets that are no more restrictive than those of their capitalist competitors. That said, beyond the specific Italian case, capitalist firms use a wider spectrum of financial assets with respect to the cooperative firms.

To reach a more conclusive comparison between the organization and governance of capitalist and cooperative firms, our previous model would have to be extended to incorporate the financial funding of the two different firms as an endogenous variable. However, this requires preliminary solution of a still open problem in the economic and legal analysis of cooperative firms: compatibility between the mutuality principle, which is a constitutive and, as such, essential characteristic of this kind of firm, and access to new financial assets.³⁰ Only by solving this problem would it become possible to combine the effort made by each worker of the cooperative firm to become one of the owners with the opportunities and management constraints in having access to different forms of funding, and then determine the consequent total costs of capital and financial debts. Such funding costs of the cooperative firm would then have to be compared with the corresponding cost of a capitalist firm, no longer confined to the particular organizational and proprietary structure in Italy but willing to gain access to different financial instruments available on the market.

As far as we know, analysis of the financial aspects in the cooperative firm is no nearer to supplying us with the answer we are looking for. Hence, rather than pursuing the goal of making the financial variables of cooperative and capitalist firms endogenous, here we just propose some more limited extensions of our model.

First of all, even if it is the most analytically developed part, managerial monitoring can be further examined and extended. A first extension concerns a more general formulation of firms' monitoring costs and organization costs as well as formalization of the related production functions. Then, with some modest algebraic complication, it would be possible to specify workers' utility functions that would not be linear but that would consider their degree of risk aversion. It would also be beneficial to diminish the contrast between short-term objectives in the capitalist firm and long-term objectives in the cooperative firm, without overlooking the distinction between the two firms and the related comparison between their degree of efficiency.

²⁹ Members' loans were initially classified as a form of risk capital and self-financing. Changes over time in their regulation have, however, shown their true economic and legal nature: a form of debt, albeit incentivized and limited to the inner circle of worker-members. Here it is impossible to address the problem in some detail and point out the distortionary impact of members' loans on the financial structure of cooperative firms. Being debt, members' loans cannot solve the problems of undercapitalization, a typical feature of cooperative firms due to their problematic access to financial markets.

³⁰ Recent legislation in Italy has allowed cooperative firms to access a large number of financial resources. It is, however, worth pointing out that, on average, cooperative firms have made marginal use of such financial opportunities.

Secondly, the removal of some further restrictive assumptions would permit a more elaborate representation of the organization of the cooperative firm. In this respect, it would be sufficient to offer a single example. Specification of a more complex utility function of the representative worker would be useful to introduce not just risk aversion but also a type of worker who does not share ownership of the cooperative firm. It would then be possible to distinguish between the utility function of worker-owners, that of worker-non-owners in the cooperative and that of workers in the capitalist firm. There is a high probability that there would be less differences between the last two functions than between the first and the second. Nevertheless, the governance of the cooperative would still differ from that of the capitalist firm, and it would be possible to better debate the benefits and costs related to participation.

Thirdly, the organizational specification of the two different kinds of firm could be related to the different technology adopted. In the Italian world of production, there is a low presence of cooperative firms in the sectors and activities on the technological frontier. This could be explained by the fact that the compared advantages of the cooperative firm are directly related to labor-intensive production processes; or it could stem from a different attitude to risk on the part of entrepreneurs with respect to worker-owners.

Fourthly, it would be possible to make a more radical change to the analytical structure of our model by introducing the separation between ownership and management control in both types of firms. The capitalist firm would not be reducible to entrepreneurial activity, since it could take the form either of a firm with concentrated shares of ownership or of a public company (diffuse ownership). That said, in both these cases in the capitalist firm the holder of property rights would be separate from the person responsible for management. On the other hand, in the cooperative firm the identification of worker-owners as managers would no longer be valid: as often happens in the real world, the management would be constituted by non-members. Hence the person responsible for management in the cooperative firm would play a role similar to that played by managers in the capitalist firm. The main analytical impact of such changes would be that, in each kind of firm, there would no longer be just one agency relationship but several of these relations (see Section. 1). To our knowledge, there is no well-set model of partial equilibrium able to analyze different agency relationships within a unified framework³¹.

Finally, an even more profound innovation would be the endogenization of the monetary wage that in our model was treated as an exogenous variable. If the monetary wage were to become a dependent variable, we would not just have a simple model of monitoring but a complex model with moral hazard (and hidden action) and with monitoring. Specification and interpretation of this kind of model would

³¹ Let us just note that, if the firm can be defined as a nexus of contracts dominated by the authority principle (see above), the roles of 'principal' and 'agents' become reversible and interchangeable. These roles would depend on the contract under exam. For instance, the holders of property rights play the role of 'principals' in their relations with managers or workers, but they tend to play the role of 'agents' in their relations with lenders. Moreover, a common label to indicate a given agency relation can hide very different problems in different firms.

represent a problem. Determination of the supervision optimal effort and optimal incentive schemes would already be a thorny problem in a unified model. Moreover, we would have to re-phrase the comparison between the two different firms in this complex new model.

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